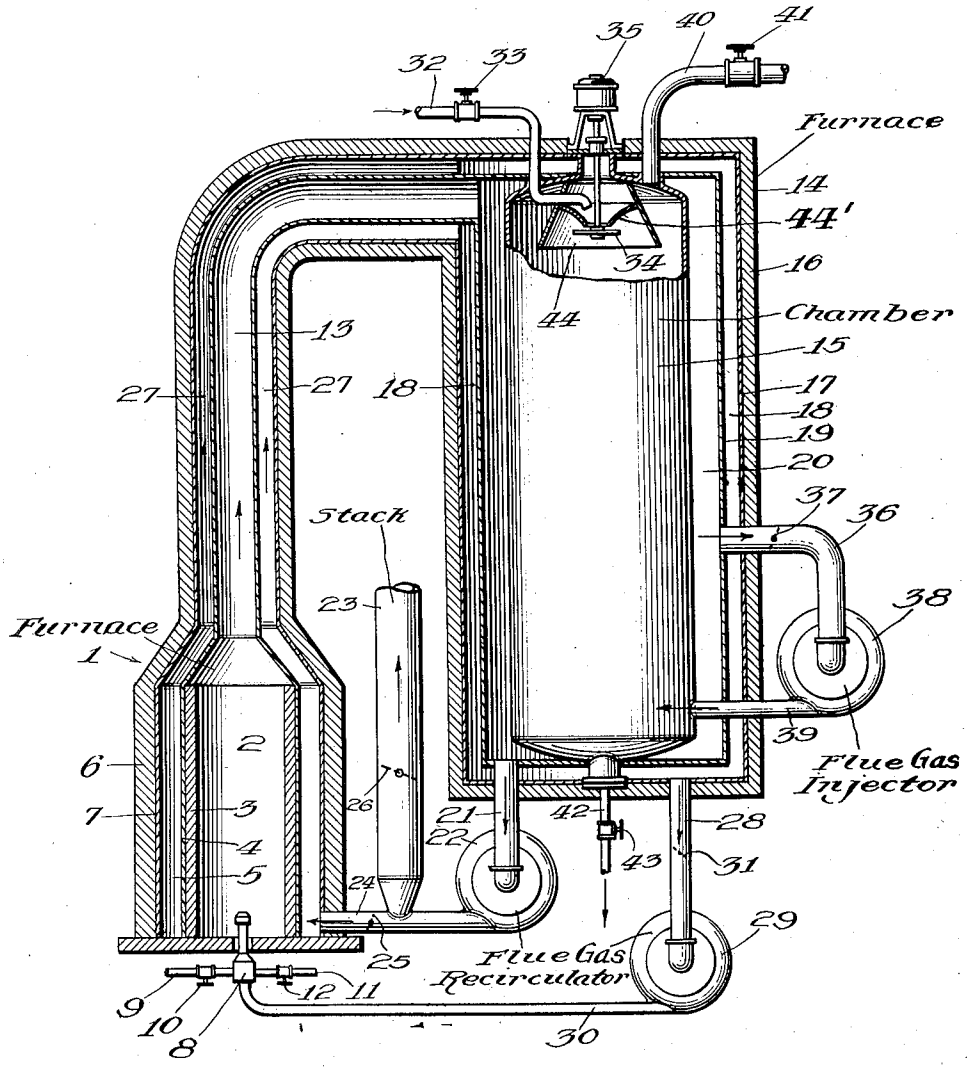
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CRACKING OF HYDROCARBON OILS

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CRACKING OF HYDROCARBON OILS

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This invention relates to the cracking of hydrocarbon oils, and refers particularly to an improved method and means of treatment, at cracking temperatures, to effect the conversion of oils into substantial quantities of more desirable products.

One specific embodiment of the invention comprises introducing hydrocarbon oil into a reaction chamber where it impinges upon a revolving disc, mounted within said chamber. The hydrocarbon stream is thereby subdivided into a substantially atomized form. Heat may be applied externally to the walls of the chamber and may be conducted therethrough to the hydrocarbons within the chamber to effect their conversion or to maintain them at any desired temperature under any desired pressure conditions. Cracked vapors may be wthdrawn from the chamber to further treatment and unvaporized residual oil may be removed from the chamber to further treatment or to cooling and storage.

As a feature of the present invention, combustion products, such as flue gas, which externally heat the walls of the chamber may be introduced into the chamber, coming into direct contact therein with the hydrocarbons to assist their conversion.

The salient features and the novelty of the invention will be apparent with reference to the drawing and the following description.

The attached drawing illustrates diagrammatically one form which the apparatus of the present invention may assume.

Referring in detail to the drawing 1 indicates a furnace having a combustion zone 2 lined with refractory material such as firebrick, carborundum brick or the like, the outer walls 4 of the combustion zone being preferably constructed of some heat resistant metallic alloy such as chrome-iron or the like although ordinary steel or cast iron or any other suitable material may be used, if desired. A space 5 is provided surrounding the outer walls of combustion zone 2, the utility of which will be hereinafter described. The external walls 6 of the furnace may be constructed of refractory material such as firebrick or may be of common brick, suitable insulating material or a combination of these. If desired, the walls 6 may be lined with a heat resistant metallic alloy 7 or if desired, may be sheathed externally with metal or insulating material, not shown. Burner 8 may supply combustible materials to the combustion zone, oil for example being introduced to the burner through line 9 controlled by valve 10 while preheated or cold air or steam is supplied through line 11 controlled by valve 12.

Furnace 14 having an outer wall 16, of suitable refractory or insulating material may be lined, if desired, with a heat resistant metallic alloy 17 or externally sheathed with any suitable material, not shown. An insulating and flue gas recirculating zone may be provided at 18 and inner wall 19 may preferably be constructed of suitable refractory or heat resistant material such as firebrick, carborundum brick or a metallic alloy. The heating zone 20 is defined between the outer walls of chamber 15 and the refractory wall 19.

Hot gases from combustion zone 2 of furnace 1 may pass through duct 13 into heating zone 20 of furnace 14, entering preferably near the upper portion of chamber 15 and passing downwardly around the walls of said chamber, which may be heated thereby. The gases may be withdrawn from the lower portion of furnace 14 through duct 21 to the flue gas recirculator 22, which may take the form of a flue gas recirculating fan or any other suitable device, and pass therefrom, in part, through stack 23 to the atmosphere. The remaining portion may pass through duct 24 to reheating zone 5 surrounding combustion zone 2 in furnace 1. The proportion of gases recirculated to zone 5 may be controlled by dampers 25 and 26 in duct 24 and stack 23 respectively. Gases thus recirculated to zone 5 may be reheated by contact with and radiation from the outer walls 4 of combustion zone 2 and may pass through duct 27 surrounding duct 13 into zone 18 of furnace 14 where they may serve to maintain walls 19 at a sufficiently high temperature to prevent excessive radiation of heat from zone 20. Reheated and recirculated flue gas from zone 18 may be withdrawn through duct 28 controlled by damper 31 to flue gas recirculator 29, which may be a flue gas recirculating fan or any other suitable device from which the gas is supplied through line 30 to burner 8 and therethrough to combustion zone 2.

Hydrocarbon oil to be treated may be introduced through line 32 controlled by valve 33 into chamber 15 and may impinge upon revolving disc 34 which may be rapidly rotated by motor 35 or by any other well known means, not illustrated. The oil discharged upon disc 34 may be substantially atomized by impingement upon the rapidly rotating disc and upon leaving the disc may be prevented from striking the heated walls of the chamber by regulation of the size and speed of the disc and the size of the chamber, or deflector 44 may be provided for this purpose and the im-

pact of the oil upon this deflector may assist in its atomization. Disc 34 may be located at any desired point in the chamber and, as here illustrated, is located in the upper portion of said chamber so that the oil discharged from line 32 may be directed, by the conical guiding member 44' disposed in the upper portion of deflector 44, to disc 34. The atomized oil may be prevented from striking chamber walls 15 by the lower portion of deflector 44 which may also serve to prevent short circuiting of insufficiently cracked vapors and atomized oil through vapor line 40. The oil in a finely divided state may thus be subjected to heating by heat radiated from or conducted through the walls of chamber 15.

If desired, a portion of the hot gases from zone 20 may be withdrawn through duct 36 controlled by damper 37 to flue gas injector 38, which may be any suitable form of apparatus, such as, a flue gas recirculating fan capable of operating at high temperature and capable of delivering gas under relatively high pressure. The gas thus withdrawn to injector 38 may be delivered through duct 39 to the interior of chamber 15, entering the chamber at any desired point or at a plurality of points. As here shown, the hot combustion gases enter chamber 15 at its lower portion and pass upwardly through the chamber coming in direct contact with the vaporized and atomized hydrocarbons, serving to heat them and assist their conversion.

Cracked vapors with or without the admixed combustion gases, as the case may be, may be withdrawn through line 40 controlled by valve 41 and may be subjected to any desired further treatment such as for example, fractionation, followed by condensation, cooling and collection of the desired light products and return of the relatively heavy components to retreatment in the same or a separate system. Oil remaining unvaporized in chamber 15 may be withdrawn through line 42 controlled by valve 43 to storage or to further treatment, as desired, or conditions may be so controlled in chamber 15 that substantially all of the volatile constituents of the oil are vaporized, the residual products being substantially dry coke which may be collected in chamber 15 and removed after the cracking operation is completed.

It will be understood that the apparatus of the present invention, as here described, may replace the reaction zone of any of the present day cracking systems or, in its preferred embodiment, replaces both the reaction chamber and the heating element; for example, the oil introduced to chamber 15 may be a relatively cold raw oil withdrawn from storage or the raw oil, before being introduced to chamber 15 may be preheated to below the cracking temperature in any suitable manner, not shown, or the raw oil may be first heated and introduced into the reaction chamber at or near the conversion temperature in which latter case the heat supplied to the hydrocarbons in the reaction chamber may be only sufficient to maintain them at substantially the same temperature at which they are introduced into the chamber or may be sufficient to substantially increase the temperature and the rate of conversion.

Pressures employed within chamber 15 may range from high superatmospheric pressures of several thousand pounds per square inch to substantially atmospheric or sub-atmospheric pressures. The pressures employed within the chamber may be substantially the same as those employed in other portions of the cracking system with which this apparatus may be used or may be substantially higher or substantially lower than the pressure employed in other portions of the apparatus. The temperatures maintained within the chamber may range from say 750° to 1200° F., more or less.

The following is given as an example of the operation of the apparatus illustrated which however, should not be construed as a limitation upon the broad concept of the invention. The raw oil charging stock to be cracked is a 36° A. P. I. gravity gas oil and after being preheated to a temperature of about 700° F. is discharged upon the revolving disc in the reaction chamber and thereby substantially atomized. Heat is supplied externally to the walls of the chamber in the manner already described and a temperature of about 1000° F. is maintained in the chamber. A pressure of about 150 pounds is maintained on the preheating element and within the reaction chamber. The vapors are subjected to fractionation, under a substantially reduced pressure of about 60 pounds per square inch, their heavier insufficiently converted portions being returned to the chamber together with the preheated raw oil and the lighter components of the vapors are condensed, cooled and collected. This operation may yield some 40% of motor fuel having an anti-knock value approximately equivalent to a blend of 70% benzol and 30% straight run Pennsylvania gasoline. In addition about 20% of heavy residual oil, suitable as charging stock for hydrogenation processes may be recovered. A small amount of substantially dry coke is produced and the remainder of the charging stock is converted into a rich gas suitable for polymerization into liquid products and particularly motor fuel of high anti-knock value or suitable for blending with gas of lower calorific value to improve the quality of the latter.

In another typical operation a Mid-continent topped crude of about 28° A. P. I. gravity is first subjected under about 200 pounds per square inch superatmospheric pressure to a temperature of about 900° F., and is discharged at this temperature upon the revolving disc of the reaction chamber. The chamber is heated, in this case only sufficiently to maintain the oil at about the same temperature at which it enters the chamber and the pressure within the chamber is maintained at about 200 pounds per square inch. The cracked vapors are fractionated, their heavier components being returned to the heating element for reconversion while their lighter components of the desired characteristics are subjected to condensation, cooling and collection. Residual liquid, withdrawn hot from the chamber is reduced to coke, in a separate low pressure zone of the same system. This operation may yield some 60% of motor fuel having an anti-knock value of approximately 50% benzol equivalent. The additional products are about 15% of pressure distillate bottoms which is highly desirable as charging stock for vapor-phase cracking, substantially dry coke and about 8% of uncondensable gas.

I claim as my invention:

1. A process for the conversion of hydrocarbon oils, comprising directly passing oil into a conversion zone maintained under a cracking temperature of approximately 1000° F. and superatmospheric pressure, immediately atomizing said oil upon its introduction into said zone and

preventing the same from contacting the walls of said zone, introducing for direct intimate contact with said atomized oil spent gases of combustion previously utilized in the external heating of said conversion zone to a cracking temperature, effecting vaporization of a portion of said oil within said zone, and removing the vaporized oil to a separate zone for further treatment.

2. A process for the conversion of hydrocarbon oil, comprising directly introducing said oil into an enlarged conversion zone, immediately impinging said oil within said zone upon a rotating surface to effect its dispersion therein while preventing contact of the atomized oil with the walls of said zone, passing highly heated combustion gases externally and entirely about said zone to maintain the same at a conversion temperature of approximately 1000° F., thereafter introducing said gases into the interior of said zone for passage therethrough countercurrent to and in direct contact with the dispersed oil, and withdrawing the vapors and gases from said zone.

3. A process for the conversion of hydrocarbon oil, comprising directly introducing said oil into an enlarged conversion zone maintained under high superatmospheric pressure, immediately atomizing and radially dispersing said oil upon its introduction into said zone but preventing contact of said atomized oil with the walls of said zone, passing highly heated combustion gases externally and entirely about said zone to maintain the same under a conversion temperature of approximately 1000° F., thereafter introducing said externally passed gases into the interior of said zone for passage upwardly therethrough countercurrent to the descending atomized oil and in direct contact therewith, removing the hydrocarbon vapors evolved within said zone, together with the spent gases of combustion, and condensing and collecting the resultant products.

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